FAX

3/20/97 A.2

MONTGOMERY WATSON

2100 Corporate Drive
Addison, Illinois 60101

Tel: (630) 691-5000
Fax: (630) 691-5133

Date: March 20 1997

To: Sheri Bianchin — 312/886-4071
Company: Luanne Vanderpool — 312/353-9281
From: Peter Vgt
Subject:



COMMENTS

Sheri + Luanne

I have a couple of questions on ACS Tech Memo comments. Please take a look at the following comments from the Approval with Modification to the Lower Aquif. Tech Memo, Dated March 3

#1

#11 ← and see attached draft response

#12

#26

#20 #21.c. #22.b. #24.

#23

#28

*If you do not receive all pages, or if there are any problems with this transmission, please call (630) 691-5000. Operator: ______ No. of pages including cover: 4*

G:\OFFICE\FORMS\FAX_FORM.DOC

11. **Page 14, Section 3.4, Groundwater Flow Direction.**

The last sentence of this section makes an unnecessary and unsubstantiated (based on gradients) assertion and should be removed. If an argument is to be made regarding significant flow directions; more information would need to be included in the argument.

**We feel the concept stated by this last sentence is necessary to a complete discussion of the groundwater flow system in the lower aquifer. The text has been expanded to provide the additional substantiation required by U.S. EPA.**

**Both the horizontal gradients and the vertical gradients are calculated by dividing the difference in water level by the distance between the points of measurement. In both cases the water levels were measured in wells (or piezometers located in generally the same vicinity, but screened at different depths). In the case of the horizontal gradients, the distance between the two measurements was the horizontal distance between the two wells. In the case of vertical gradients within the same aquifer, the distance was measured between the centers of the wells screens, and in the case of vertical gradients calculated across the clay confining layer, the distance was measured as the total thickness of the clay confining layer.**

**The water elevation is calculated from two measurements, each measured to the nearest 0.01 foot. The first measurement is the top of casing elevation, which is established to Site datum by survey. The second measurement is the measured depth to the water below the top of casing. If it is assumed that each of these measurements is accurate to within one-half of the smallest unit of measurement, it is evident the margin of error for any groundwater elevation calculated for the Site is 0.01 foot.**

**If a water level difference is measured to be 0.01, it is within the margin of potential error and therefore it must be regarded as indistinguishable from zero (0.0). This fact can be used to calculate the smallest quantifiable gradient between any two measurement points.**

**For example, a horizontal gradient is calculated for the lower aquifer between MW22 and MW10. The gradient is calculated by dividing the difference in groundwater elevation between the two locations, by the distance between the two wells. The result of this calculation is presented in Section 3.4 of the Lower Aquifer Technical Memorandum and indicates a horizontal gradient across the Site of 0.00047. To calculate what the lowest quantifiable horizontal gradient is, one takes the lowest quantifiable groundwater elevation difference (0.01) and divides it by the distance between the two wells. This calculation (0.01 ft / 2,850 ft) indicates that a horizontal gradient of 0.0000035 would be indistinguishable from a gradient of zero, for this setting.**

The lowest quantifiable vertical gradient can similarly be calculated for each well nest location. From Table 6, we find that the well screen separation distances vary between 14 feet and 33 feet. The following tabulation shows that the lowest quantifiable vertical gradient in the lower aquifer with the existing well nests ranges between 0.0007 and 0.0003.

| Potential Error | Screen Separation | Lowest Quantifiable Gradient |
|---|---|---|
| 0.01 ft | 14 ft | 0.00071 |
| 0.01 ft | 33 ft | 0.00030 |

Table 6 shows the calculation of 15 vertical gradients. Nine of them are within the range between 0.0003 and 0.0007. Therefore, 60 percent of the vertical gradients are in essence, indistinguishable from zero. Nine of the calculated gradients have negative values, indicating a downward direction and five have positive values, indicating an upward direction. Given the fact that calculated gradients are both vertical and horizontal, and that a majority of calculated gradients are indistinguishable from zero: "It is reasonable to conclude that the primary motive force acting on groundwater is horizontal, with small locally controlled vertical components."

# Table 6
## Vertical Gradient Calculations
## Lower Aquifer Investigation
## American Chemical Service, Inc.
## Griffith, Indiana

| Well Nest | Screen Interval | | Screen Midpoint | Separation (feet) | Groundwater Elevation | | | | Vertical Gradients In Lower Aquifer | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Top | Bottom | | | Upper | Middle | Lower | delta | Upper/Middle | Middle/Lower | Upper/Lower |
| MW7 | 595.9 | 590.9 | 593.4 | | 622.4 | | | | | | |
| PZ44 | 578.4 | 573.4 | 575.9 | 18 | | 622.37 | | -0.03 | -0.002 | | |
| MW36 | 552.7 | 542.7 | 547.7 | 28 | | | 622.36 | -0.01 | | -0.0004 | -0.0009 |
| MW8 | 598.2 | 593.2 | 595.7 | | 621.98 | | | | | | |
| MW31 | 574.6 | 564.6 | 569.6 | 26 | | 621.96 | | -0.02 | -0.0008 | | |
| MW32 | 547.3 | 537.3 | 542.3 | 27 | | | 621.98 | 0.02 | | 0.0007 | 0.0000 |
| MW9 | 605.9 | 600.9 | 603.4 | | 622.29 | | | | | | |
| MW29 | 585.9 | 575.9 | 580.9 | 23 | | 622.26 | | -0.03 | -0.001 | | |
| MW34 | 552.8 | 542.8 | 547.8 | 33 | | | 622.28 | 0.02 | | 0.0006 | -0.0002 |
| MW10 | 603.0 | 598.0 | 600.5 | | 621.86 | | | | | | |
| MW30 | 585.0 | 575.0 | 580.0 | 21 | | 621.75 | | -0.11 | -0.005 | | |
| MW33 | 556.0 | 546.0 | 551.0 | 29 | | | 621.77 | 0.02 | | 0.0007 | -0.002 |
| MW28 | 588.7 | 578.7 | 583.7 | | 622.97 | | | | | | |
| PZ42 | 568.5 | 563.5 | 566.0 | 18 | | 622.95 | | -0.02 | -0.001 | | |
| PZ43 | 554.5 | 549.5 | 552.0 | 14 | | | 622.99 | 0.04 | | 0.003 | 0.0006 |
| M4 | 586.42 | 581.42 | 583.92 | | NA | | | | | | |
| MW35 | 551.8 | 541.8 | 546.8 | | | | 622.46 | | | | NA |

Notes:
(-) = Downward Vertical Gradient
(+) = Upward Vertical Gradient
Water Levels Collected by Montgomery Watson on March 15, 1996
NA = Not Applicable. Water elevations for the City of Griffith Landfill well M-4 were not available.

RJR\rjd\MHG\dap\PMS
J:\M077\techmemo\ACSVG3.XLS